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ART. I.—*A New Method for securing Divided Vessels; and on the Use of Carbolic Acid in Surgical Operations for facilitating Union by First Intention.* Read (by invitation) before the Dutchess County Medical Society, at Poughkeepsie, January 9, 1869. By FREDERIC D. LENTE, M. D., of Cold Spring, Honorary Member of the Society.

FOR many years the inconveniences and even dangers of ordinary ligatures have been appreciated by surgeons, and their ingenuity has been taxed to provide some efficient substitute. Several devices, more or less valuable, have been recommended, and, to some extent, experimented upon. These have all been of too recent introduction, however, and their use too restricted, as yet, to permit of a judgment as to their respective merits.

Animal ligatures have had a trial long ago. *Acupressure* has been quite extensively tried in Great Britain, where it originated; but from the fact that, after a very considerable lapse of time, and a very considerable amount of experiment and commendation from surgeons of high authority, another mode of treating arteries (by torsion) has been brought forward by British authority, and has been highly commended also, it seems evident that *acupressure* has not acquired the confidence of British surgeons generally. It has been but little employed in this country as yet; not so much as its apparent merit deserves. It cannot be considered, therefore, as a substitute for the ordinary ligature. The recommendation of *torsion*, or rather its revival, is quite recent; for it was experimented upon long ago, and, in a measure, forgotten. This method has been lately applied to arteries of all sizes, and to every variety of operation, and reported upon by surgeons of recognized authority. According to these reports, it has succeeded in every instance. If the subsequent experience of other surgeons should coincide with that of the few who have thus been bold enough to trust to it, we may certainly claim it as one of the most valuable improvements of the present day in surgery. But, I imagine, it will be long before the most positive assurances of safety from surgeons of the greatest eminence, and the most imposing array of statistics to back them, will induce the great mass of surgeons to trust the femoral, or the brachial, or the tibials to simple twisting for a security againt secondary hemorrhage; especially in country surgery, where the surgeon may be separated from his patient by miles. I foresee one serious objection to the plan; unless the fact asserted by its author be demonstrated beyond a doubt by a much larger experience "that a hemorrhage once completely arrested by torsion cannot recur." It is this: that as the artery, say the femoral or brachial, requires to be drawn out of its sheath for a considerable distance, in order to be twisted properly, secondary hemorrhage, if it *should* occur, would come from a point so high among the tissues of the stump, from the retraction of the divided vessel, as to render its subsequent ligature a very difficult matter.

There still remains, then, a desideratum in this respect; some simple contrivance like the old silk ligature, which every one can understand and apply in all cases, and to all vessels, and to which the disadvantages of the ligature shall not pertain. I beg leave, but with becoming diffidence, to recommend such a one to the profession, because it is not already established by sufficient experimentation, but introduced to notice in the hope that my professional brethren, or some of them, may deem it of sufficient importance to assist me in establishing its value, or the reverse. The idea is simply this: cut off a length of silver wire, say three inches, less will do, however, for small arteries; give it a sharp bend in the middle, then one or two twists as near the bend as possible. This forms the ligature. *Mode of application.*—Secure the twisted end of the ligature in a pair of spring or catch forceps, and it is ready. Draw out the vessel to be ligated, or, if a small one, the tissue in which it is, with a tenaculum or forceps, in the usual manner; let an assistant apply the ligature against the vessel at the point where the two legs diverge from the twist; then the surgeon takes hold of the two ends and gives as sharp a twist on the vessel as possible, and then secures the hold by two or three half turns. The silver wire is so soft and pliable that but very few turns are necessary to prevent slipping. After a little practice, these ligatures may be applied with great facility. At first, it is a little awkward compared with the silk ligature, but compared with any other mode of securing vessels it is more simple. As regards the size of the wire, the surgeon will perhaps use his own judgment; but I have used ordinary *suture* wire for the smaller arteries, and a larger wire, No. 26, for large arteries. The suture wire would be strong enough to hold any artery, I think; but if drawn tightly it would probably be more liable to damage the inner coats, which is not desirable, and there is more uncertainty in making the twist take a firm hold of the artery while tightening the larger wire. The surgeon, having twisted the wire, cuts off the end with ordinary scissors, within two or three turns of the artery; the other end, if not too long, may be left, as we thus avoid having *two* sharp ends to the ligature. This leaves a very minute quantity of metal around each vessel, so little in fact that, after a dozen such ligatures have been applied, it becomes somewhat difficult, in course of half an hour, to find one of them, except by searching carefully. They soon imbed themselves in the tissues, and disappear from sight.

The advantages of this mode of ligating are obvious, provided we can be secure against further trouble from the foreign substances left in the wound. I was induced to believe that pure silver would become encysted, and would thus not give rise to any future inconvenience from the fact that substances, much more likely to irritate and inflame the tissues, remain in them harmless for an indefinite time. For instance, rough leaden bullets of irregular shape, even pieces of iron, if clean; needles have been frequently known to remain for many years in various tissues of the body, not only without producing any inflammation, but without making the subject aware of their presence; except, perhaps, when in travelling, as they often do, long distances, they interfere with some important nerve. The non-liability to give rise to inflammation, or even irritation, in these cases, is not the exception, but the rule. May we not, therefore, reasonably infer that small particles of pure silver will seldom produce inflammation and suppuration; and that even if they should do so, as we must expect they will, in exceptional cases, the evil would be far less serious or annoying than those incident to other modes of securing vessels, especially to the ordinary silk ligature, with which we have at present to compare this method.

It is becoming generally admitted by surgeons that it is better to *compress* the inner coats of an artery merely for the arrest of the current through it, than to destroy their integrity.[1] The danger of secondary hemorrhage especially appears to be much less. But, in using the ordinary ligature, it is necessary to tie very tightly, or there is risk that, in the further manipulation of the wound, it may be drawn off the vessel; or, what is worse, become so loosened that it may be detached prematurely after closure of the wound, and thus give rise to secondary hemorrhage. There being no ends to be pulled upon in the case of the wire ligature, there is no necessity to twist so tightly as to injure the coats of the vessel. In the case of patients whose blood is in a very bad condition from disease, from imperfect nutrition, exposure, fatigue, &c., circumstances which constantly pertain to the wounded of large armies, who have often to be transferred long distances before receiving proper care or nourishment, the great danger, after operations, is from *secondary hemorrhage.* And, under the above conditions, this occurs only a few days after the operation, before the usual time of separation of the ligature. In such cases the coagulum is slow in becoming consolidated; and there being only the thin outer coat of the artery left intact, and this compressed by a foreign substance of an extremely irritating character, ulceration readily ensues, and the soft coagulum is forced out. These accidents happened so constantly at a military hospital near Fortress Mónroe, of which the writer had temporary charge during the war, as to excite considerable discussion among a number of distinguished surgeons congregated there, as to its cause, among them Professors W. Parker and A. H. Stevens, of New York. These patients had been, for the space of eight days, which elapsed after the battle of Williamsburgh, and before their arrival at Old Point Comfort, subjected to various privations and discomforts, including exposure, and very insufficient nourishment and even water. I feel that the lives of many of these poor fellows might have been saved by the use of the wire ligature, after amputation especially; particularly if applied so as not to destroy the continuity of the arterial coats.[1] During the progress of operations, where a considerable number of ligatures are required, the management of the numerous long threads, which have become more or less entangled and glued together by the constantly forming coagula, is frequently a source of no little embarrassment. And this is particularly the case when we have to reopen a wound for secondary hemorrhage. Two of the cases included in this paper illustrated the advantages in this respect, of the silver ligature. Another advantage of silver wire over silk is that the former never breaks; while, in the hands of the most competent surgeons, I have seen great annoyance and dangerous delay, in securing arteries, occur from the constant breaking of the silk ligature, especially in tying the second knot, and this is more apt to occur during the excitement produced by rapid and profuse hemorrhage, just when it is most important that it should *not* occur. A circumstance, which renders the superiority of the permanent over the temporary ligature more conspicuous, is the recent introduction of the use of *carbolic acid* for surgical dressing, to which I shall presently invite attention.

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[1] Dr. Warren Stone, of New Orleans, as long ago as 1859 (see *N. O. Med. and Surg. Journ.*, Sept. 1859), enunciated this theory, and put it into practice.

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[1] Dr. McParlin, Medical Director of the "Army of the Potomac" during its operations under General Grant, informs me that the wounded, sent to the different hospitals, after the *first* battles of the Wilderness, and while they were in fine physical condition, progressed favourably, and that secondary hemorrhage was not common; but that the wounds of those sent from the subsequent battles progressed badly, and that secondary hemorrhage was frequent; and this occurred, as in the cases under my charge at Fortress Monroe, within an unusually short period after operations; due, as he supposes, to the impoverished, aplastic state of the blood, induced by fatigue, exposure, and want of proper variety of food.

The following cases are those in which I have employed the silver ligature. Two of them are, however, too recent to be of much assistance in enabling us to judge of the ultimate action of the wire. At some future time, the final result of the treatment, whatever it may be, will be published.

CASE I.—Mrs. M., sister of a physician of good standing in Pennsylvania, was recommended to consult me about a tumour of the left breast which had been growing rather rapidly. It was undoubtedly malignant, and its removal was at once decided upon. In consultation with Drs. McParlin and Wiggin, of the army, I determined to use the wire ligature for securing the vessels. The operation was performed on the 17th of August last; and, with the assistance of the above named gentlemen, I applied eleven ligatures to bleeding vessels; ten of silver, one of silk, when the wire was exhausted. This was a very unusual number for such an operation, and the advantage of the wires was thereby manifested to all of us, in one respect, that is, in facilitating the sponging of the wound and the searching among the tissues for bleeding points, after a number of ligatures had been applied. After all oozing had ceased, I brushed over the wound (before the patient had recovered from the effects of the ether) a mixture of one part of carbolic acid (solid) to two parts of glycerine and water. It whitened the tissues immediately, like a strong solution of nitrate of silver, and seemed, for a time, to increase the oozing; after this had again mostly ceased, the mixture was again applied. The patient, on recovering from the effects of the anæsthetic, felt no unusual smarting of the wound, in fact less than usual. The edges of the wound were accurately brought together with a number of fine sutures of silk, and a strip of lint, saturated with a solution of solid carbolic acid in an equal quantity of glycerine, was applied over the line of junction, and a bandage applied.

21st. No appearance of inflammation whatever; not even any tenderness except on pretty firm pressure. The strip of lint remains firmly adherent. No change of dressing.

23d. Patient has an attack of dysentery, to which she has been subject for several years. Yesterday there was a little suppuration at the lower corner of the wound, where I had introduced a small tent for fear of concealed pus.

25th. The inflammation has extended slightly upwards, and a circumscribed induration is felt at one point.

28th. Opened a small abscess.

September 1. The abscess healed almost immediatly after the evacuation of its contents; a slight discharge at the lower corner of the wound; no tenderness on pressure over any other part of the wound.

December 11. For some time a loose wire has been floating about in the situation of the abscess; but the skin over it is perfectly sound, and there is no inflammation under it. It has given no inconvenience except a pricking now and then. It was no doubt detached by the suppuration around it. One end was pushed against the skin, a small incision made, and the wire removed, looking clean and bright. Another is felt in close proximity to this; but as it is probably adherent, it is not disturbed.

Remarks.—This was an unfavourable case both for the success of the wire and of the *carbolic acid.* The patient was in an exceedingly feeble condition, labouring under chronic uterine disease, for which she had been under treatment for nearly a year; and also under *prolapsus recti*, and chronic intestinal catarrh, and her blood was in a very impoverished state. During the healing of the wound she was attacked with jaundice, and a carbuncle of considerable size formed over the left hip; and yet almost every part of the wound united at once. She is now, February 6th, 1869, still under treatment for her various infirmities, and her wound gives her no inconvenience whatever.

CASE II.—This was a reamputation by the circular method (of the thigh) by Dr. Geo. Murdock, my assistant, December 17th, 1868. I had amputated the leg (crushed by a coal car) some three weeks previously, when the patient was almost pulseless from shock and loss of blood, and he was also in a bad state of health, suffering from chronic diarrhœa. Sloughing of the upper flap took place. Patient was in a very feeble condition when the second operation was performed. I applied nine ligatures, three of No. 26 wire; one of these on the femoral artery, and one on the vein, and six ligatures of ordinary suture wire. This was an unusual number of ligatures; but there was an unusual disposition to hemorrhage, and on this account it was thought best not to close the wound except by merely approximating the edges with a few adhesive strips.

Six hours after the operation, Dr. M. was summoned, and found the stump bleeding profusely, and patient well nigh exhausted. He found a number of bleeding points, but one large jet in particular; this vessel had retracted to such an extent that he traced it up full two inches under the integument before he secured it. He tied some four or five other vessels with the silk ligature; as he had neither silver wire on hand nor medical assistance. He did not see a single one of the nine silver ligatures during his long manipulation of the wound, except that on the femoral artery. He thought that if he had had nine silk threads floating about in the wound, the tedious process of finding and securing the bleeding points, with no proper assistance, would have been still more tedious; and that, in the very feeble state of the patient, the additional delay might have caused the sacrifice of his life. He was able to ascertain positively, from his knowledge of the situation of the silver ligatures, that the hemorrhage did not come from any artery previously secured by them, but from entirely different points of the wound.

The patient is now, February 6th, doing well; the stump soundly healed and giving no trouble, though he is still having occasional attacks of diarrhœa.

CASE III.—On the 29th of December, 1868, I amputated the forearm of a healthy young man for gunshot wound. With the assistance of Dr. Murdock, I applied six suture wire ligatures to as many bleeding vessels, including the radial, ulnar, and interosseous; a solution of one part of carbolic acid in three parts of glycerine and water was then brushed freely over the wound, which was brought together with fine silk sutures, and a compress soaked in a mixture of carbolic acid and glycerine (equal parts) placed over it, and a bandage over the whole. There was a considerable oozing of dark, bloody matter after the sutures were applied, which was pressed out of the wound as far as possible before the application of the bandage.

January 6, ninth day. The wound has been doing remarkably well, except that there is no union by first intention. There was considerable oozing of dark, bloody fluid for a couple of days, and it is now suppurating. There has been no heat, swelling, or redness, and no pain from the time of his recovery from the anæsthesia up to the present time.

February 6. The stump has been soundly healed for some time, and gives no trouble whatever.

CASE IV.—I performed, November 3, 1868, partial amputation of the hand, with the assistance of Dr. Murdock, for injury by a circular saw, and applied one silver ligature to a bleeding vessel of some size. The wound was then brushed over with the carbolic acid mixture, and loose dressings applied. The wound, of course, healed by granulation; and, after a week or more, the wire ligature was discharged.

CASE V.—Mrs. P. This was an amputation of the leg, above the ankle, for gangrene of the foot caused by embolism of the iliac artery. Patient had been an invalid for several years, and had been confined to bed for months from the effects of an intra-uterine tumour, profuse menorrhagia, &c. An extensive bed-sore had formed over the *sacrum*, and smaller ones elsewhere; both lower extremities were very œdematous, the œdema extending above the hips. Patient was, of course, in a very unfavourable condition for operation, but it was imperatively demanded.

I operated on the 18th January, by the circular method, assisted by Drs. McParlin and Marsh, of the army, and Dr. Murdock. Applied the silver ligatures to the anterior and posterior tibial arteries, and one other, and twisted the others. Then brushed the stump freely with diluted carbolic acid (one part to 9) and dressed with sutures, adhesive strips, and bandage.

January 20. No swelling or other signs of inflammation, and no discharge; removed bandage and plasters.

21*st*. A discharge of a few drops of turbid serum from one point. Water dressings; the wound, as far as the integument is concerned, has apparently united throughout; the adhesion having been broken up with the probe at the point above mentioned. Water dressings.

February 12. The adhesions all melted away, and the stump has remained in a perfectly inactive, lifeless condition until the past few days; but now, under the influence of injections of diluted carbolic acid, some attempts at a reparative action are manifested.

CASE VI.—Mrs. C. This was an amputation of the leg, by the circular method, which I performed on the same day as the last, and with the assistance of the same gentlemen. It was undertaken for the removal of a very interesting disease of the tibia, a form of *osteitis*. This patient was likewise in a very unfavourable condition for the operation, from long suffering, and only recently nursing a baby. Although the disease was situated below the middle of the tibia, and apparently only affecting that bone, it was ascertained, after amputation, that all the bones of the foot, and both the tibia and fibula, throughout their whole length, were much softened, and their compact tissue much attenuated. The stump, as in the last case, was in a most unfavourable state for close dressing; but we all thought it advisable to attempt it; and after applying four silver ligatures, and brushing over the stump with the carbolic acid solution (1 to 9), it was dressed in the same manner as the last.

February 12. Patient continued in a very low condition for several days after the operation, retaining almost nothing in the stomach, and nourished by nutrient and stimulating enemata. On the day succeeding the operation, the stump was doing quite well and dressings not disturbed. But on the day following this, it became swollen and painful, and the dressings and sutures were all removed, and gave egress to a quantity of unhealthy pus, clots, and detritus of various kinds, and clear oily matter from the tibia. Owing to the general condition of the patient, the stump, for some time, remained in a very inactive condition, secreting only a serous fluid. But after injections twice a day of a solution of carbolic acid (1 part to 20), it assumed a much more healthy state, and has quite filled up with tolerably healthy granulations.

Subsequent to these operations, and while engaged in preparing this paper, I first became aware, through my friend Dr. E. J. Marsh of the Army, of Dr. B. Howard's valuable experiments on metallic ligatures, detailed before the New York Pathological Society last winter, and with the earlier experiments of a somewhat similar nature alluded to in the discussion which followed the presentation of his interesting specimens. (See *New York Medical Record* and number of this Journal for January, 1868, page 282.) But I can nowhere discover that any one has yet experimented upon the use of the wire ligature for arresting hemorrhage in general operations.[1] From Dr. Howard's experiments, too few as yet, however, to settle the point, it would seem to be a matter of very great importance to place the ligature on the vessel as *loosely* as is consistent with safety and the attainment of the desired object. For in the two cases in which this was done, no irritation followed, and the wire became safely encysted. But, in all the cases in which a ligature (of whatever material) was tied, or twisted *firmly* about the artery, some suppuration, and the subsequent extrusion of the ligature ensued.

This happened when the ligature was placed around the continuity of the vessel. Whether the same result will follow its application to the divided extremity of the vessel remains to be proved. There are reasons for believing that such will not be the case, and Professor Howard himself seems to think so. In ligating the small arteries, during an operation, there is usually some surrounding tissue taken up with the vessel, and this protects the latter to a sufficient extent probably to prevent destruction of any of its coats, without any special caution on the part of the operator. In ligating an artery of any size, drawn out from its sheath, it would be better, in the present state of our knowledge on the subject, to twist the wire just firmly enough to prevent its slipping off; and the latter will not easily happen, as the vessel and ligature are soon retracted out of sight, and out of the way of being disturbed even by quite rough manipulation of the wound, as has been thoroughly demonstrated in all my operations.

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[1] It may seem singular that the notice of these experiments should not have fallen under my observation earlier, but they were reported and discussed during my absence from the country last winter, and their record has remained buried under an accumulation of journals on my shelf to the present time.

An important object, in substituting silver wire for silk in ligating arteries divided in operations, is of course to secure a better chance for "union by first intention." By this, we not only avoid, to a considerable extent, unseemly cicatrices, and secure a more rapid convalescence for the patient, but, what is of more importance, we diminish the danger of death from an open, suppurating wound with its constant liability to erysipelas, pyæmia, exhaustive discharge, and a long train of evils, of which hospital surgeons, at least, are but too well aware, especially those attached to the Parisian hospitals. In close connection with the use of silver wire for promoting "union by first intention," comes in another recent improvement in surgery, the employment of *carbolic acid*. Mr. Lister's recommendation of its use, only a short time since, for promoting the rapid healing of *accidental* wounds of every description has been extensively acted upon, and apparently with very considerable success; though, it is alleged, sometimes with detriment. But I am not aware that any surgeon has yet applied it to ordinary surgical operations, with the object of preventing[1] inflammation and suppuration, except myself. I propose to give briefly the histories of a few cases in which I have so employed the remedy:—

CASE I.—This was a lady of good personal appearance, who had a fatty tumour, the size of a walnut, just between the eyes, and extending nearly to the *canthi*. She had been deterred from having it cut for a year or two, because her physician said it would be followed by a scar. I was therefore very anxious to prevent suppuration if possible, a contingency almost sure to happen, under ordinary circumstances, in a cavity in a situation where it was almost impossible to keep the sides in accurate apposition. I accordingly determined to use *carbolic acid;* and—after the oozing had nearly ceased—applied freely, by means of a brush, a solution of the acid in glycerine and water, one part to three; the wound was then dressed with sutures, and covered with lint wetted with the solution (50 per cent. of acid) and a light compress. The next day there were redness and swelling; the third day this subsided, and the sutures were removed, the wound having healed throughout; and the fourth day she returned to the city; there is now scarcely a perceptible cicatrix.

CASE II.—This was the case of a female who had a neglected *paronychia* of index finger, which resulted in necrosis of the last *phalanx*. I made an incision over it, removed the bone, and applied the solution (one part to three) freely, and directed her to dress it with lint wetted with a solution (one part to twenty). Three days afterwards, I saw it, and there had been no inflammation. It healed well without suppuration.

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[1] This was true when the above was written, but just as the proof-sheets of this article are passing through my hands I find, by a recent London journal, that some English hospital surgeons were trying these experiments contemporaneously with me, and with great success. I find, also, that Mr. Lister had recommended to soak silk ligature in carbolic acid, to tie the vessels with it, cut the ligature short, and close up the wound. Mr. Maunder, surgeon to the London Hospital, has used this in one instance on the carotid, and with complete success.

CASE III.—Mr. S. had a *carbuncle* on the cheek already ulcerated, and spreading quite rapidly. The induration and tumefaction extended to the articulation of the jaw, beyond the base and angle, and upwards nearly to the *zygoma;* in fact, involving almost the whole of that cheek. To have incised this in the ordinary way, and to have applied the ordinary treatment, would have insured a disfiguring cicatrix of considerable magnitude. I accordingly determined to employ the subcutaneous method and the carbolic acid in conjunction. A narrow straight bistoury was passed through the small opening in the centre of the disease, and passed under the skin to a little beyond the outline of the inflammation, and an incision carried downwards entirely through the induration. This was done in four directions, making a crucial incision. A solution of solid *carbolic acid* in an equal part of glycerine was then injected into each incision, causing quite sharp pain, which soon subsided. The wound was covered with lint wetted with the same solution. Each day, for five or six days, the injection was repeated with a weaker solution; the pain never recurred after the operation, and within two weeks the part was soundly healed almost without a scar.

CASE IV.—A. J. was chopping wood with a very sharp axe, and struck the edge directly over the *patella.* It bled profusely, but it was bound up, and he was brought in a wagon, a distance of three miles, to my office. I found a clean cut some three inches in length, and beneath it a firm clot of such a size as to make a tumour as large as a small orange. This had checked the hemorrhage. I scooped, with the fingers, all of this out from under the flap made by the glancing of the axe, and then compressed the sides of the wound firmly against the bone (the joint was not opened) to check the bleeding. Dr. Murdock then painted the whole wound thoroughly with a solution of carbolic acid in glycerine (equal parts), and having carefully pressed out the muddy fluid caused by the action of the acid on the blood constantly oozing, I applied sutures and straps, then a compress wet with the acid solution; then a pretty firm bandage, and finally a guttered splint the whole length of the limb to insure quiescence of the joint. The application of the acid caused the most severe pain, but it passed off in a few minutes, and when patient left the office he stated that he was in less pain than when he entered.

To be brief, the patient rode home, and not the least appearance of inflammation was ever observed about the wound. On the twelfth day he was at his work in the woods.

CASE V.—This case has already been alluded to. It was a terrible laceration of the hand by a circular saw; a portion of the hand and two fingers were removed; the thumb was torn partly off at the metacarpal joint. Union by first intention was not attempted, but the carbolic acid solution (one part to two) was freely applied with the view of preventing inflammation.

Second day.—No heat, and but very trifling pain or tumefaction about the wound. The dressings have not been removed, but the solution has been applied over the dressings and allowed to soak through; there has been considerable oozing of bloody serum.

Seventh day.—Moderate suppuration, but very little swelling or inflammation. No other dressing since the bandages were removed, but a light compress wetted with a weak solution (one part to twenty) of the acid. The wound healed soundly.

CASE VI.—Mr. W. applied to have a fatty tumour, measuring about three inches across, removed from his right shoulder. The operation having been performed with the assistance of Dr. Murdock, a solution of carbolic acid in glycerine and water (one part to three) was freely applied, the edges brought together with fine sutures of silk, the oozing fluid pressed out, a strip soaked in a 50 per cent. solution of the acid in glycerine placed over the line of junction, and finally a compress and bandage over all.

Second day.—No sign of inflammation, but complains of a severe neuralgic (?) pain running from the wound through and around the shoulder joint. Pressure upon the wound does not increase it. This continued several days, became periodical, and was finally relieved by large doses of quinia and hypodermic injection of morphia. The wound healed soundly, but to make sure that there was no concealed matter giving rise to the pain, the adhesion of the skin was broken up at one point, and a probe passed to the bottom of the wound; there was after this a slight suppuration in the limited portion of the wound thus interfered with, and water dressings were applied.

CASE VII.—See Case III. of the first series, on a preceding page of this paper.

CASE VIII.—This was a circular amputation of the leg (has already been alluded to in Case II., first series). The patient in a desperate condition from previous ill health, shock, and loss of blood; immediate amputation necessary to stop the hemorrhage. The surface of the stump was thoroughly brushed over with the ordinary solution of carbolic acid in glycerine and water; the edges of the integument brought together with sutures and adhesive straps, and a moderately tight roller applied, as there was a disposition to considerable oozing. The patient lingered in a doubtful condition for several days, vomiting almost everything taken into the stomach, and passing away almost everything injected into the rectum for nutriment and stimulation. He finally rallied, but the upper portion of the covering of the stump sloughed. There never was any sign of inflammation about the wound.

CASE IX.—See Case I., first series. Also V. and VI.

The success of the carbolic acid, in all these cases except the amputations, is certainly sufficient to warrant a further trial of the remedy.

Whether its application to *stumps* will be of any assistance in expediting union remains as yet in doubt. My experiments, so far, certainly do not present the plan in a favourable position for future imitation. But my cases were all, with a single exception, very unfavourable for a successful trial; and I still hope that future results, even in the case of stumps, may present the matter in a more favourable aspect. In every instance, however, the application of so severe an agent, instead of producing irritation and pain, as one would naturally expect, evidently mitigated, in fact almost annulled the suffering which usually follows for some hours the dressing of large wounds on recovering from the anæsthesia. In the first amputations the solution was unnecessarily strong; the only inconvenience thereby occasioned being the apparent increase of oozing from the surface of the wound.

There is one case on record of the application of the silver ligature on the continuity of a vessel (the femoral) in the human subject, the wire being cut off and the wound closed up. I allude to Mr. Broadhurst's very interesting case, published in the London *Lancet;* and there is another, not on record, a recent operation by Dr. Stephen Rogers, of New York, in which Professor Howard, at his request, applied the silver wire to the femoral, cut it short, and closed up the wound. In both cases the operation was for *aneurism.*[1] It does not come within the scope of this paper, and would extend it to an undue length to detail these very instructive cases, for the particulars of which I am indebted to Dr. Rogers. But it is proper to remark that they both illustrate the importance of the principle partially established by Dr. Howard's experiments on animals—viz., that the compression of the coats of the artery, by a ligature of whatever kind, should not be sufficient to injure any of them, especially in cases where disease of the arteries is suspected. This principle has also recently been experimented on by Dr. Gurdon Buck, of New York, and, through his recommendation, by some of his friends. They have performed several operations for aneurism by means of a method of applying the ligature devised by Dr. Buck, which he intends, at a proper time, to bring before the profession, and which I am not at liberty to describe now.

COLD SPRING, Jan. 9, 1869.

ART. II.—*Researches on the Physiology of the Cerebellum.* By S. WEIR MITCHELL, M.D., Member of the National Academy of Sciences.[2]

DURING the last six years I have at various times engaged in studying the difficult subject of the physiology of the cerebellum. Like most observers, my experiments have been made chiefly, but not altogether, upon

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[1] Only quite recently, and since this paper was read, I have met with the record of another instance in which the silver ligature was applied, cut short, and closed up. This was the operation of Dr. Stone previously alluded to in this paper. He applied the ligature *loosely* around the *common iliac artery.* Everything, as far as the wound was concerned, went on well, and the man lived until the twenty-sixth day, when he succumbed to chronic dysentery, &c. (See *N. O. Med. and Surg. Journ.*, Sept. 1859.)

[2] The conclusions of this paper were communicated to the Biol. and Micr. Dept. hila. Acad. Nat. Sci., Jan 18, 1869.